Total Pages—5

MCA (II)
SCM 2006

Second Semester Examination, 2004

NUMERICAL METHODS

Full Marks : 70

Time : 3 hours

Answer **Q. No. 1** which is compulsory and any **five** from the remaining questions

The figures in the right-hand margin indicate marks

1. (*a*) Write the accuracy of the numbers: 0·008472, 0·0456000.

(*b*) Which of the following numbers has the greatest precision ?

4·3201, 4·32, 4·320106

(*c*) Write the orders of convergence of the methods: Newton-Raphson method, secant method.

(*d*) State Cramer's rule for the solution of linear system of three equations.

(Turn Over)

(e) Define least squares regression for curve fitting.

(f) State Simpson's $\frac{1}{3}$ rule for

$$\int_a^b f(x)\,dx.$$

(g) State Trapezoidal rule for

$$\int_a^b f(x)\,dx.$$

(h) Write the solution of

$$\frac{dy}{dx} = f(x, y),\ y(x_0) = y_0,$$

by third order Runge-Kutta method.

(i) Write the predictor and corrector with respect to the differential equation

$$\frac{dy}{dx} = f(x, y),\ y(x_0) = y_0.$$

(j) Obtain the eigenvalues of the following matrix :

$$A = \begin{bmatrix} 0 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix}$$

2 × 10

(Continued)

2. (a) Find the absolute error in $w = xy + z$ if $x = 2{\cdot}35$, $y = 6{\cdot}74$ and $z = 3{\cdot}45$. 5

(b) Estimate the relative error in $z = x - y$ when $x = 0{\cdot}1234 \times 10^4$ and $y = 0{\cdot}1232 \times 10^4$ as stored in a system with four-digit mantissa. 5

3. (a) Find a real root of the equation $x^3 - 2x - 5 = 0$ by the method of false position correct to three decimal places. 5

(b) Solve $\sin x = 1 + x^3$ using Newton-Raphson method correct to five decimal places. 5

4. (a) Solve the following system of equations :

$$8x - 3y + 2z = 20,$$
$$6x + 3y - 12z = 35,$$
$$4x + 11y - z = 33,$$

by Gauss-Seidel iteration method correct to four decimal places. 5

(b) Solve the following system of equations :

$$10x + y + z = 12,$$
$$2x + 10y + z = 13,$$
$$x + y + 5z = 7,$$

by Gauss-Jordan method. 5

(Turn Over)

5. (a) Fit a straight line to the following set of data :

x	1	2	3	4	5
y	3	4	5	6	8

5

(b) Fit a quadratic polynomial to the following set of data :

x	1	2	3	4
y	6	11	18	27

5

6. (a) Evaluate $\int_0^1 \frac{dx}{1+x^2}$ by Simpson's $\frac{3}{8}$ rule considering seven ordinates. 5

(b) Find the first, second and third derivatives of $f(x)$ at $x = 1{\cdot}5$ from the following data :

x	1·5	2	2·5	3	3·5	4
$f(x)$	3·375	7	13·625	24	38·875	59

5

7. (a) Using improved Euler's method solve the differential equation

$$\frac{dy}{dx} = 1 - y,\ y(0) = 0,$$ at $x = 0{\cdot}1,\ 0{\cdot}2,$ and $0{\cdot}3$, correct to three places of decimals. 5

(Continued)

(b) For the differential equation

$$\frac{dy}{dx} = x^2 - y,\ y(0) = 1,$$

find $y(0{\cdot}1)$, $y(0{\cdot}2)$ using fourth order Runge-Kutta method. 5

8. (a) Determine the largest eigenvalue and the corresponding eigenvector of the matrix

$$\begin{bmatrix} 1 & 2 & 0 \\ 2 & 1 & 0 \\ 0 & 0 & -1 \end{bmatrix}$$

by iteration method. 5

(b) Find the coefficients of the characteristic polynomial of the following system of equations :

$$(1+\lambda)\, x_1 = 0,$$
$$x_1 - (2+\lambda)\, x_2 + 3x_3 = 0,$$
$$2x_2 - (3+\lambda)\, x_3 = 0.$$

5